

Puget Sound Nutrient Modeling to meet Clean Water Act Objectives

Washington State Department of Ecology, Pacific Northwest National Laboratory, and U.S. EPA Region X.

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Nutrient pollution is considered one of the largest threats to Puget Sound. Recognized nation-wide, the following characteristics of nitrogen pollution apply equally and imperatively to Puget Sound (Howarth, 2006):

- Human acceleration of the nitrogen cycle over the past 40 years is far more rapid than almost any other aspect of global change.
- Nutrient pollution leads to hypoxia and anoxia, degradation of habitat quality, loss of biotic diversity, and increased harmful algal blooms.
- Technical solutions exist and should be implemented, but further scientific work can best target problems and solutions, leading to more cost effective solutions.

This paper describes a plan for the Washington State Department of Ecology (Ecology) and Pacific Northwest National Laboratory (PNNL), working collaboratively with EPA and a scientific advisory group, to conduct nitrogen pollution modeling in Puget Sound, to complement concurrent management initiatives. This work is being conducted as part of EPA's and Ecology's mandate under the Clean Water Act to manage pollutant loading to meet water quality standards.

Project Objective

Use Puget-Sound-wide hydrodynamic models at two scales to answer the following nutrient management questions:

- Are current nitrogen loadings from point and nonpoint sources in and around Puget Sound significantly impacting water quality at a large scale?
- What level of nutrient reductions are necessary to reduce or eliminate human impacts to biomass and dissolved oxygen levels in sensitive areas?

Project Description

This project consists of the following:

- I. Establish two multi-purpose hydrodynamic models for the entire Puget Sound, one at a large scale (Babson et al., 2006) and one at an intermediate scale. These models can also serve as community tools for other purposes.
- II. The large-scale model (also called "box model") will be used to produce a screening-level evaluation of nutrient effects on dissolved oxygen, Puget-Sound-wide. The results of this effort will inform the intermediate-scale model.
- III. The intermediate-scale model (also called "coarse grid model") will be used to evaluate the effect of human-caused nutrient enrichment on dissolved oxygen across Puget Sound. This model will help inform potential Puget-Sound-wide management strategies and decisions and would support site-specific detailed work that may be completed beyond this project.

A technical advisory committee composed of scientists will be used to help advise this work.

The chart below shows three scales of models and the water quality information to be used for nutrient modeling at each scale. This project builds the models for the box and coarse grid scales. Detailed nutrient modeling efforts at the high-resolution scale are currently on-going for sub-basins of Puget Sound by various organizations: Hood Canal (Hood Canal Dissolved Oxygen Program), [Sinclair/Dyes Inlets](#) U.S. Navy), and South Puget Sound (Ecology). Modeling is also planned for Quartermaster Harbor by King County.

Hydrodynamics (3-D water circulation)		Application	Types of Watershed Data Sources for Nutrient Modeling	Types of Point Source Data Sources for Nutrient Modeling
Box Model	→	Screening-level analysis of nutrient dynamics	Existing USGS and Ecology information	Extrapolated South Puget Sound data
Coarse Grid	→	Estimation of point and non-point source impacts on Puget Sound DO	Existing information and empirical/statistical approaches	Expanded voluntary South Puget Sound monitoring to all Puget Sound
High-resolution Grid (to follow or parallel this proposed project)	→	Detailed analysis of sensitive areas; may be used to set load and wasteload allocations	Site-specific data collection and watershed loading models	Site-specific data collection

Tasks

- Write project plan.
- Establish technical advisory committee.
- Define model selection criteria (hydrodynamics and water quality).
- Evaluate candidate models; select (advisory committee plays significant role).
- Develop models at 2 scales: box and coarse.
- Use existing data as described above (no new data collection).
- Compare model results to areas with finer-scale grid such as South Puget Sound and Hood Canal.

Schedule July 1, 2008 to June 30, 2010

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References

Howarth, R., 2006. From presentation to the White House Office of Science and Technology Policy by Robert W. Howarth, *David R. Atkinson* Professor of Ecology & Environmental Biology, Cornell University, November 3, 2006.

Babson A., Kawase, M., and MacCready, P., 2006. Seasonal and Interannual Variability in the Circulation of Puget Sound, Washington: A Box Model Study. *Atmosphere-Ocean* 44(1) 2006.